Space Weather Technical Forecast

Issued on Friday, 29 April 2022 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Storms Likely today and tomorrow, chance of G2/Moderate Storms tomorrow. Chance of M-class flares (R1/R2 Radio Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with occasional C-class flares observed, the largest a C6.7 from ex-2996 in the northwest quadrant at 28/0306 UTC, and the most recent a C3.7 flare at 28/1812UTC from AR2994. There are currently eight numbered sunspot regions on the visible disc. AR2994 (Eho/Beta-Gamma) in the far northwestern quadrant remains the most complex. The remaining sunspot groups are all rather simple with mostly small magnetic regions, or are benign alpha spots.

An associated CME was observed following the C6.7 flare, and although the CME itself is not Earth directed it may interact with an earlier CME that is potentially Earth directed. A prominence eruption was observed off the southeast limb, beginning around 28/0300UTC. A CME associated CME with the eruption is not expected to be Earth directed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, was at slightly elevated to elevated levels, generally between 480-520 km/s, and peaked at 551 km/s at 28/1912 UTC. Density remained at average levels. The Interplanetary Magnetic Field (IMF) Bt was often at moderate levels, peaking at 10 nT, through the morning to mid-afternoon, after which the Bt declined to weak levels. The north-south component, Bz, was predominantly weakly negative, reaching -7 nT at 28/0620 UTC. The phi angle was mostly positive (away from the Sun). Geomagnetic activity started at Active levels (Kp 4) and then declined Quiet to Unsettled (Kp 2-3) from 28/0600 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at background levels throughout. The high energy electron flux (greater than 2MeV) has been at background to moderate levels throughout, peaking at 405 at 28/1715 UTC. The associated 24 hour fluence remained below the Active (1e8 integrated pfu) level, with an initial decreasing trend followed late in the day by a slightly increasing trend. At 29/0000 UTC 7.17e7 integrated pfu was recorded.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low, with a chance of Moderate activity and a very slight chance of High activity.

Solar Wind / Geomagnetic Activity: Current modelling suggests the potential arrival of a CME which left the Sun around 27/1450UTC, either late today or early tomorrow. The CME from the 28th may catch up with this first CME and interact, possibly helping to make the CME more likely to brush Earth.

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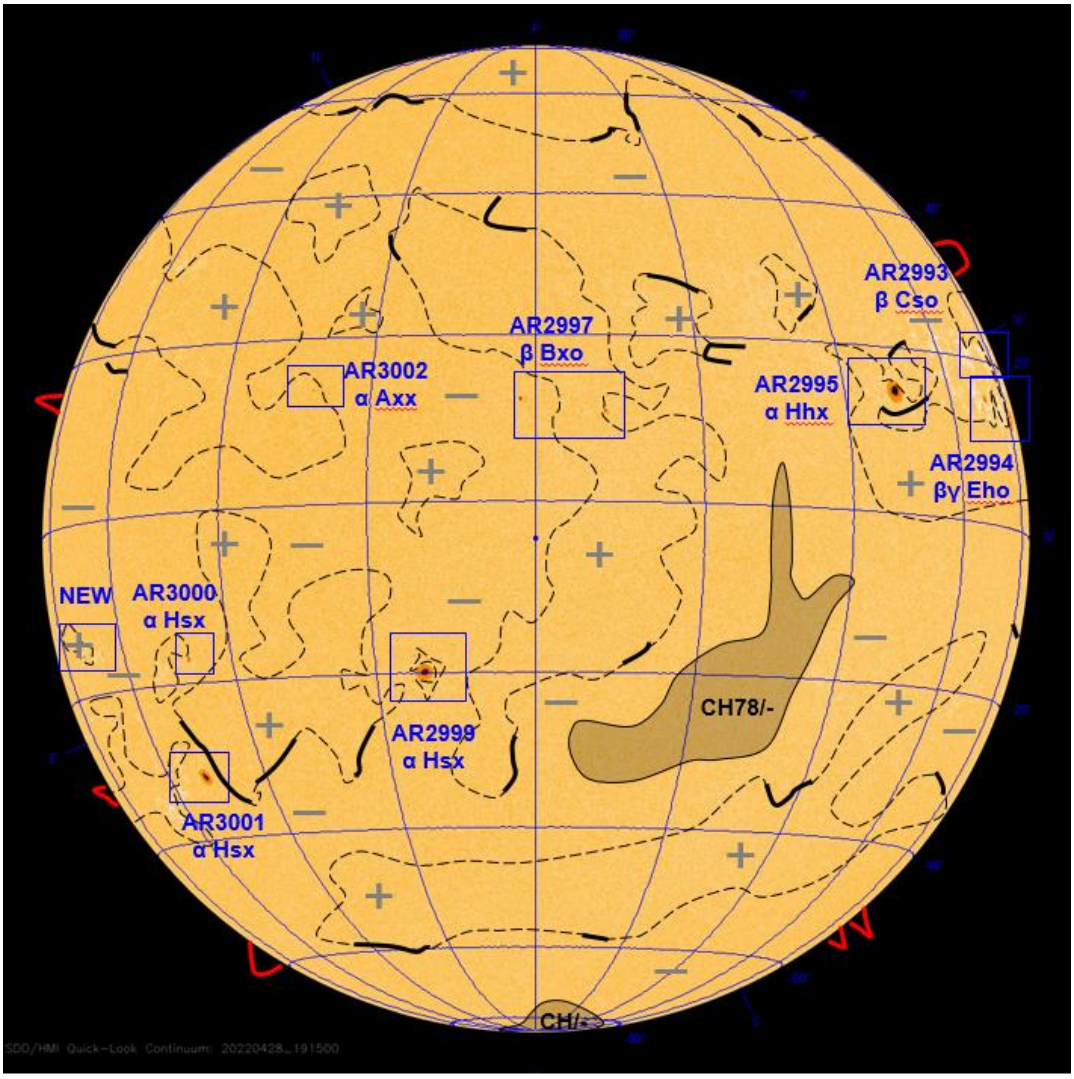
Meanwhile the onset of a high speed stream, from Coronal Hole 78, is expected to arrive today. Later today the solar wind speeds are likely to increase to 550-600 km/s, under the combination of the potential CME arrival and the HSS. Speeds will then likely decrease to slightly elevated levels from late day 3 (1st May) onwards. Geomagnetic activity is forecast to be mainly Unsettled to Active (Kp 3-4) today, with a chance of G1/Minor Storm (Kp 5) intervals. During the 30th April the geomagnetic activity is expected to increase Unsettled to G1/Minor Storm (Kp 3-5), with a chance of G2/Moderate Storm (Kp 6) intervals before easing back to Quiet to Active (Kp 2-4) during day 3 (1st), and then Quiet to Unsettled (Kp 1-3) during day 4 (2nd).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at background levels, and is most likely to remain so through the next four days. The high energy electron flux (greater than 2MeV) is expected to be at mainly background to moderate levels, but with an increasing trend towards the high (1e3 pfu) threshold. The corresponding electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold but with a rising trend, especially from day 3 (1st May).

Figure 1. Solar Analysis Valid 28/1915 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME is expected to arrive at Earth either late today or more likely tomorrow morning. This CME originated form a long duration C7 flare in the northern hemisphere of the Sun, peaking around 27/1450UTC. It's positioning and lack of imagery has meant that several analyses have taken place, with below average confidence in the detail. Although, evidence suggests that this CME may catch up with another CME released from a similar position a number of hours earlier, perhaps gathering material. Its initial velocity was around 800-900km/s but this will likely become 550-600km/s (chance of 650km/s) upon arrival at L1 and Earth.

Solar winds are currently elevated. Later today the solar wind speeds are likely to increase to 550-600 km/s, under the combination of the potential CME arrival and the HSS. Speeds will then likely decrease to slightly elevated levels from late day 3 (1st May) onwards.

Geomagnetic activity is forecast to be mainly Unsettled to Active (Kp 3-4) today, with a chance of G1/Minor Storm (Kp 5) intervals. Tomorrow the geomagnetic activity is expected to increase Unsettled to G1/Minor Storm (Kp 3-5) with a chance of G2/Moderate Storm (Kp 6) intervals before easing back to Quiet to Active (Kp 2-4) during 1st May, and then Quiet to Unsettled (Kp 1-3) during day 4 (2nd).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	80	30	10
Strong	G3	No	1	1	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
27/2138	Partial	C7 flare	NW quadrant	830	30/0200 +/- 6hrs	Possible glancing blow

Figure 2: MOSWOC Enlil showing the potential CME arrival on the 30th.

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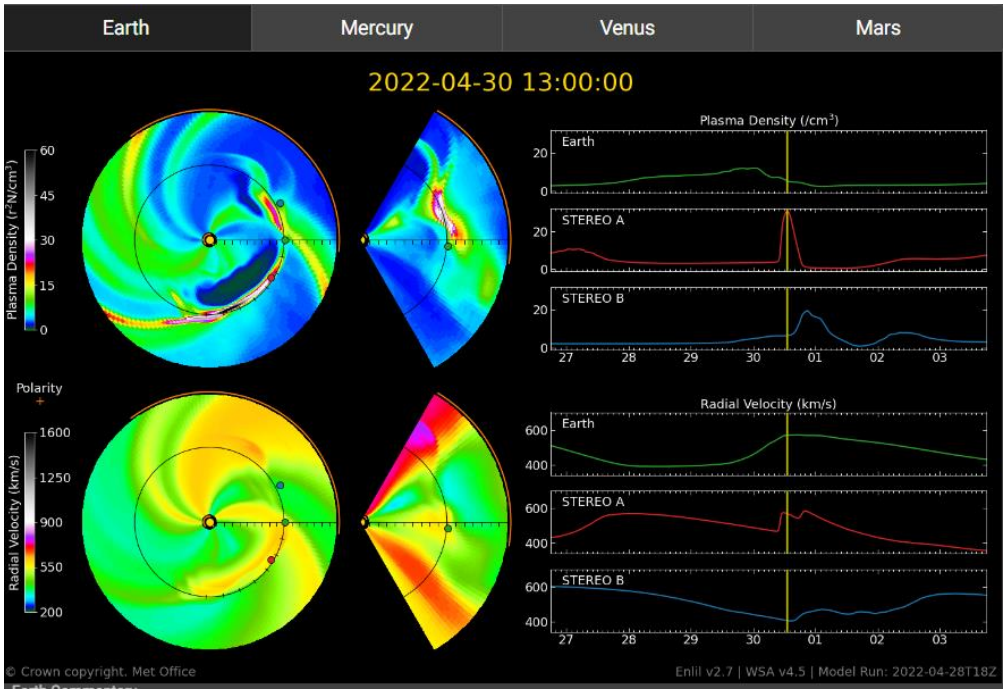
Met Office Space Weather Technical Forecast



Radio Blackouts - X-Ray Flares:

Solar activity has been Low, with occasional C-class flares in the past 24 hours, the largest a C6.7 from ex-2996 in the northwest quadrant at 28/0306 UTC, and more recently a C3.6 from AR2994. There are currently eight numbered sunspot regions on the visible disc. Both AR2993 and AR2994 are becoming tricky to analyse at they approach the northwest limb, but AR2993 remains small and stable, and possibly decaying, while AR2994 persists as the most complex region on the disc, probably still a Beta-Gamma configuration, but with a slight reduction in size of the trailing spots. AR2997 remains a rather long bi-polar region in the northern hemisphere, simplifying to a Bxo/beta. AR2995, 2999, 3000, 3001, and 3002 all appear to be stable unipolar regions. There is one further small, weak group towards the far southeast limb which is currently un-numbered. A number of filaments are being monitored for potential eruptions, especially in the western hemisphere which could result in an Earth-directed CME.

Solar activity is expected to be Low to Moderate over the next four days, with a very slight chance of High activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	20	20	10
Very Active	R3 to R5 X Class	No	5	5	3	3

Solar Radiation Storms - (High Energy Protons):

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The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels, and is most likely to remain so through the next four days. However, AR2994 brings a none-zero chance of isolated proton storms from it's slightly inflated flare risk.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

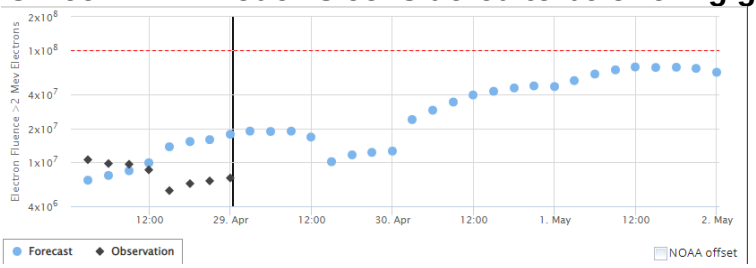
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is expected to vary between background and moderate levels at first in a benign solar wind environment. The CIR ahead of the next high speed stream (Coronal Hole 78) is then likely to compress the radiation belts and redistribute electrons, leading to a drop in the flux. A possible CME arrival early 30th may then also reduce the electron field further, perhaps with a recovery in counts possible by 01 May. A more significant increase in the electron count is expected through day 4 (2nd), perhaps reaching the High threshold (1000 pfu).

Electron fluence values are likely to remain below the Active threshold (1e8 integrated pfu) through the period, but with a rising trend toward the end of the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	20	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: The Met Office REFM model is considered to be offering good guidance.



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